MEMOIRS
FOR THE
INGENIOUS.
CONTAINING

Several Curious Obſervations in *Philoſophy*, *Mathematicks*, *Phyſick*, *Philology*, and other Arts and Sciences.

IN
Miſcellaneous Letters.

By *J. DE LA CROSE*, E.A.P.

JANUARY, 1693.

To be continued Monthly.

VOL. I.

F. 27 Line

———— *Erat quod tollere velles*
Garrulus atque piger ſcribendi ferre laborem
Scribendi rectè, nam ut multum nil moror. Hor. ſerm. l. 1. ſat. 4.

———— *Cui non ſit publica vena*
Qui nihil expoſitum ſoleat deducere, nec qui
Communi feriat carmen triviale moneta. Juven. ſat. 7.

LONDON, Printed for H. Rhodes near *Bride-lane* in *Fleet-ſtreet*;
And for J. Harris at the *Harrow* in the *Poultrey*. 1693.

BIBLIOTHECA BODLEIANA

ADVERTISEMENT.

SUch as have any Books, Letters, Memoirs,or other Papers to communicate tothe Author of theſe *Memoirs*, are intreated to ſend them to the *Latin* Coffee-houſe, in *Ave-Maria lane*, near *Ludgate* : and defray the charge of Carriage.

An ingenious Gentleman having undertaken to write a *General Hiſtory of Fountains*, he deſires the Aſſiſtance of the Learned, in order to finiſh ſo uſeful a performance. And therefore if any have Advices, Experiments or Papers of the like Nature, to impart to him, he is intreated to ſend 'em to the Author of theſe *Memoirs*, under the former direction. Or if any had the ſame Deſign, and had ſo far advanc'd it, as to be ready for the Preſs, he is deſired to give notice of it to the ſaid Author, that his Friend may deſiſt from a fruitleſs Undertaking.

Memoirs for the Ingenious,

JANUARY 169$\frac{2}{3}$.

LETTER I.

ARGUMENT.

The difficulty of writing Journals: What can make 'em of a long ſtanding. Occaſion, Method and Matter of theſe Memoirs. An Invitation to our Virtuoſo's. *Various opinions about the Original of Fountains. Obſervations of* Mr Sedileau, *a Member of the* French *Academy of Sciences, concerning the quantity of Rain-water, and that of its Evaporation.*

SIR,

I Fear you will never leave off quarrelling with me for having diſcontinu'd the Writing of the *Works of the Learned.* I have diſcover'd to you as to an intimate friend, the particular cauſes of my diſguſt, which the publick is not concerned to know. This only I ſhall repeat here, that Experience has taught me the perfect eſtabliſhing of a Journal, ſo as I underſtood it, is not the performance of private men. And therefore we ſee a vaſt difference betwixt the Journals that have been ſet up in ſeveral Countries, as to their ſucceſs and continuance. The Journals of *Italy* have been laid down twice or thrice. The *News from the Republick of Letters*, tho undertaken by an incomparable *Genius*, has been but of five or ſix years ſtanding: the *Univerſal Bibliotheque* has loſt its two firſt Authors, and is but a Skeleton, if I may ſpeak ſo, of what

it was before: The *History of the Learned*, publiſhed at *Rotterdam*, by a moſt ingenious Pen, is fallen from a monthly to a quarterly account of five or ſix ſheets; whereas the Journals of *France* and *Germany*, whoſe Authors are encourag'd by their Princes, grow every day better, eſpecially the firſt, ſince the *French* King, at the perſwaſion of that great Miniſter *Louvois*, has beſtowed a Penſion upon three or four learned men, to purſue that undertaking.

Societies erected for the promoting of Learning have almoſt undergone the ſame fate, for the *Royal Academy of Sciences* at *Paris*, whoſe chief members have either Offices, or a competent Allowance from that Monarch, beſides the great works they are upon, and publiſh from time to time, have ſince a year begun to give out ſmall, but moſt valuable obſervations, upon ſuch Subjects as occur to them in all parts of Philoſophy, Phyſic and Mathematics. And ſuch acceptance have their Memoirs found among their Nation, that whereas at firſt they were printed monthly, they began to publiſh them every fortnight, on the 15th of *March*, 1692, and have often continued on that foot.

We have here a Royal Society too, and compos'd of as able and ingenious men as any in the World; however ſince the Death of the Learned and Induſtrious *Oldenburg*, we have ſeen but few of their Papers. Not that they have diſcontinu'd their ingenious inquiries and obſervations, or that they eſteem the World unworthy of communicating 'em; but it ſeems that the *Engliſh* Tongue being circumſcribed within the narrow limits of this Nation, the Sale of ſuch Books, as are only fitted for the uſe of the moſt curious and thinking ſort of People, will not allow a ſufficient Reward to the Undertakers. In the mean time, nothing can more contribute to the progreſs of Learning, than the ſpeedy publiſhing of ſmall papers, which contain new inventions or rare obſervations; for tho their Authors, ſhould be glad to be taken for what they are, yet as the learned'ſt are ordinarily not the richeſt ſort of men, ſo they are loth to appear on the public Stage, at the expences of their Purſe, as well as of their Wit.

Beſides there are but few, who have ſo much time to ſpare, as to write huge Volumes, and they know that flying Sheets and Sixpenny Books, are as ſoon loſt as printed; which things being all put and conſidered together, it will not ſeem ſtrange, if the Learned be thereby diſcouraged from publiſhing their Works.

Theſe Reflexions and your Earneſtneſs have at laſt determin'd me to ſend you theſe *Memoirs* in the form of *Miſcellaneous Letters*. I have ſeveral Treatiſes lying by me, which I am neither minded, nor at leiſure

leiſure, ever to inlarge into a Book. Beſides I have the *Journal* of *Paris*, and the *Phyſical and Mathematical Memoirs* of their Royal Academy, of the laſt year, and I am promiſed that thoſe of the preſent year ſhall be conſtantly ſent to me every fortnight by the Poſt; ſo that unleſs ſome unforeſeen accident ſhould hinder the Effect of my good will, you may be ſure to receive from me every month at leaſt, if not oftner, a Book of this bigneſs.

But I hope our ingenious *Engliſh* Men will not put me to ſuch ſtraights, as continually to borrow from our Enemies the matter of a Philoſophical Entertainment. For tho the Lovers of Wiſdom can never be at real feuds, yet there may be a noble emulation, and lawful ſtrife, between two neighboring Nations, which of them ſhall contribute more to the diſcovery of the Truth, and the perfection of Arts and Sciences. Let then our *Engliſh* men ſhow themſelves as brave at the Pen, as at the Sword; and we may be ſure of getting the Victory in this kind of ſpiritual fight. As long as the *Philoſophical Tranſactions* have been conſtantly continued, they have been eſteemed the beſt collection that ever appeared in the world; moſt of the Perſons who have contributed to that excellent performance are yet living, or have been ſucceeded by others who may equal the Reputation of their Predeceſſors, ſo that I do not doubt, but if our Royal Society and other Learned men will help on the writing of theſe Memoirs, they may come in time to yield neither in curioſity, nor uſefulneſs to thoſe of the *French* Academy.

For tho I have mentioned theſe laſt Memoirs, the Journal of *Paris*, and ſeveral of my Papers, do not believe, Sir, that I will obtrude to the world, either Tranſlations, Abſtracts, or my own Compoſures; I look upon them only as a Forlorn Hope to begin the Fight, to raiſe up the Spirits of the Learned, or as a *Body of Reſerve* to maintain it, and hinder this deſign from falling on a ſudden. For this reaſon it is, that I have not inſerted Divinity in the Title, being afraid that, as it is known, this is the part I am beſt converſant in, ſome men would be apt to believe, I deſigned to put upon them a Book of my own making. Notwithſtanding as Chriſtianity, excepting matters of fact, the moral part and the revealed truths, is the beſt Philoſophy and pureſt Metaphyſics, ſo, any Papers that ſhall relate to the reconciling of our Myſteries with ſound Reaſon, or the differences among Chriſtians, explaining an important paſſage of the H. Scripture, or of any prophane Author; in a word, all what is new, ſhort and rare, and may make men more learned and good, *Noſtri eſt farrago libelli*, ſeems to me fit *Memoirs for the Ingenious*.

But not to detain you any longer with Prefaces, you have often ask'd my opinion about the original of Fountains and Rivers; whether they were formed and kept up by the Rain, or whether they proceeded from the exhalation of Vapors, driven up from the bottom of the Earth to its ſurface, by the fermentation of Minerals and heterogeneous bodies, or by ſubterraneous fires? This queſtion is not eaſy to be determin'd; for it depends upon many previous inquiries and experiments, as whether the Earth is ſo exactly and regularly pierc'd through, in all the places which correſpond to the Springs of Rivers, that the Vapors raiſed by this Fermentation and Fire, may go up and purſue their way without hinderance, till, at the top, or the foot of Mountains, they condenſe and fall down into Water. This difficulty would incline me to the opinion of thoſe, who make Rain the ſource and the ſtore of Rivers, but that this Hypotheſis is likewiſe liable to a great objection, *viz.* That the quantity of the Evaporation, ſurpaſſes by far that of the Rain, even in the wetteſt Countries. Beſides that there are ſome as *Languedoc*, that are abundant with Fountains and Rivers, where it rains but very ſeldom, and the Snow that falls upon the Mountains ſeems not proportionable to the quantity of water that runs through the Channels of theſe Rivers. Add to this, that it is hard to conceive that ſuch a conſtant effect as the ſource of Rivers ſhould proceed from ſo variable a cauſe as the fall of Rain and Snow, which ſo ſenſibly differs in ſeveral Climates, Seaſons and Years. Theſe objections how ſtrong ſoever they appear, are not altogether unanſwerable, but cannot, methinks, be fully reſolv'd than by natural experiments, and accurate collations between the quantity of Rain fallen within a certain time, and that of its Evaporation. And therefore I am minded to gather up all the experiments of this Nature, that ſhall come to me from known and ingenious hands, before I give you my laſt determination upon this matter.

I have happily met in the Memoirs of the Royal Academy, for *February*, with ſome Obſervations of M^r. *Sedileau* relating to this. He took two Pewter Ciſterns, one, which was to receive the Rain, and to meaſure the quantity of that Water, had 2 foot in length, and 1½ in breadth and depth: The other that was prepared to obſerve the degrees of the Evaporation, was 3 foot long, 2 broad, and ſomething above 2 high. He put each of theſe Ciſterns into a Wood-caſh broader and longer than the Ciſtern, and filled up the void ſpace with Earth, to hinder, as much as poſſible, that no part of theſe Ciſterns but their mouth ſhould be expoſed to the action of the Air, Wind and Sun. He ſet theſe Veſſels upon the terraſs of the Obſervatory

ſervatory at *Paris*, in an open place, and having begun his Obſervations on the 1ſt of *June* 1688, he continued them to the laſt of *December* 1690, when a ſickneſs of his interrupted the courſe of theſe experiments.

To meaſure the Rain-Water, he put, at one of the corners of the bottom of the Ciſtern fitted to receive the Rain, a Tap, by which as ſoon as it began to rain, the water fell in a *Cubical* Veſſel 3 inches long, broad and high, which conſequently contain'd 27 *Cubic* inches of water. Theſe 27 inches of water lying level upon the baſis of the Ciſtern, were found by calculation and experience, to be raiſed $\frac{3}{4}$ of a line above it, and therefore as often as this ſmall Veſſel was taken away, it was a ſign that it had rain'd $\frac{3}{4}$ of a line high; and that the water ſhould have no time to evaporate, it was meaſured as ſoon as it was fall'n, and the Ciſtern fully evacuated.

To take notice of the evaporation, he filled up the other Ciſtern to half a foot from its uppermoſt brink, leſt the Veſſel being too full, the agitation of the wind ſhould ſpill the water. Every day the diſtance from the uppermoſt brink of the Ciſtern to the ſuperficies of the water was meaſur'd, by the means of two rules, whereof one, which was pierc'd through the middle, lay horizontally and level upon the brink of the Ciſtern, and the other, which was divided into inches and lines, enter'd vertically into the hole of the firſt. Now to know how much Water had been evaporated within a certain time, as a month, he added to the quantity, mark'd by lines upon the Rule, the quantity of the Rain-water that was fall'n during that month, ſuppoſing it to be known, as having obſerv'd it, by the means of the other Ciſtern.

The reſult of his Obſervations are as follow.

Anno MDCLXXXVIII.

	Rain.				Evaporation.			
June	2 Inch.	9	Lin.	$\frac{1}{4}$	June	5 Inch.	10	Lines.
July	1 Inch.	9	Lin.		July	5 Inch.	4	Lin.
Auguſt	0 Inch.	3	Lin	$\frac{3}{4}$	Auguſt	5 Inch.	4	Lin.
September	1 Inch.	7	Lin.		September	3 Inch.	2	Lin.
October	1 Inch.	8	Lin.	$\frac{1}{6}$	October	1 Inch.	5	Lin.
November	1 Inch.	7	Lin	$\frac{2}{3}$	November	0 Inch.	8	Lin.
December	1 Inch.	9	Lin.	$\frac{1}{2}$	December	0 Inch.	8	Lin.
Sum of the Rain	11 Inch.	6	Lin.	$\frac{1}{3}$	Sum of the Evaporation	22 Inch.	5	Lin.

Anno

Anno M DC LXXXIX.

	Rain.			Evaporation.			
January	1 Inch.	4	Lines.	January	0 Inch.	8	Lines.
February	0 Inch.	9	Lin. $\frac{3}{4}$	February	0 Inch.	9	Lin.
March	0 Inch.	9	Lin. $\frac{3}{4}$	March	1 Inch.	10	Lin.
April	1 Inch.	4	Lin $\frac{1}{6}$	April	3 Inch.	0	Lin.
May	0 Inch.	7	Lin. $\frac{3}{4}$	May	5 Inch.	7	Lin $\frac{1}{2}$
June	0 Inch.	8	Lin $\frac{3}{4}$	June	4 Inch.	8	Lin.
July	4 Inch.	3	Lin. $\frac{1}{2}$	July	5 Inch.	3	Lin $\frac{1}{2}$
Auguſt	1 Inch.	6	Lin.	Auguſt	4 Inch.	11	Lin. $\frac{2}{3}$
September	1 Inch.	8	Lin.	September	3 Inch.	2	Lin. $\frac{1}{2}$
October	1 Inch.	10	Lin. $\frac{1}{3}$	October	1 Inch.	3	Lin. $\frac{1}{4}$
November	2 Inch.	5	Lin. $\frac{1}{3}$	November	0 Inch.	11	Lin. $\frac{1}{3}$
December	0 Inch.	8	Lin.	December	0 Inch.	8	Lin.
Sum of the Rain	18 Inch.	1	Lin.	Sum of the Evaporation	32 Inch.	10	Lin. $\frac{1}{2}$

Anno M DC XC.

	Rain.			Evaporation.			
January	2 Inch.	7	Lines.	January	0 Inch.	8	Lines.
February	1 Inch.	2	Lin.	February	0 Inch.	6	Lin. $\frac{3}{4}$
March	1 Inch.	7	Lin. $\frac{1}{4}$	March	1 Inch.	6	Lin.
April	0 Inch.	10	Lin. $\frac{3}{4}$	April	3 Inch.	6	Lin. $\frac{1}{2}$
May	2 Inch.	6	Lin.	May	4 Inch.	8	Lin.
June	2 Inch.	3	Lin. $\frac{3}{4}$	June	4 Inch.	8	Lin. $\frac{3}{4}$
July	2 Inch.	8	Lin. $\frac{1}{3}$	July	5 Inch.	5	Lin. $\frac{3}{4}$
Auguſt	2 Inch.	11	Lin.	Auguſt	4 Inch.	2	Lin. $\frac{1}{4}$
September	0 Inch.	9	Lin. $\frac{1}{2}$	September	2 Inch.	6	Lin. $\frac{1}{4}$
October	2 Inch.	4	Lin. $\frac{1}{2}$	October	1 Inch.	10	Lin.
November	0 Inch.	10	Lin. $\frac{1}{4}$	November	0 Inch.	8	Lin. $\frac{3}{4}$
December	0 Inch.	4	Lin.	December	0 Inch.	6	Lin.
Sum of the Rain	31 Inch.	0	Lin. $\frac{1}{3}$	Sum of the Evaporation	30 Inch.	11	Lin.

Mr. *Sedileau* farther obſerves,

1. That the greateſt quantity of Rain, which is fallen during thoſe 2 years 7 months, within the ſpace of 24 hours, was 12 lines $\frac{1}{4}$ in height, *June* 20, 1688, and 13 lines at another time, *July* 13, 1689.

2. That

2. That ſome times, when the Rain ſeem'd pretty ſtrong, and to have continued half a day long; however it was found that it had rain'd but 3 or 4 lines in height, becauſe the drops were thin, and that Rain does not make up a conſiderable quantity of Water, unleſs the drops be ſomewhat thick.

3. That the greateſt evaporation that has happen'd at *Paris* during that time, within 24 hours, has been 3 lines $\frac{1}{2}$, in the heat of Summer, the Sky being moſt pure and clear, and the Wind blowing North, North-Eaſt.

4. That Water is eaſier evaporated in a ſmall Veſſel than in great, provided they be alike in all other things.

5. That ſix inches of Snow give ordinarily but about an inch of Water, when the Snow is melted; which muſt be underſtood of the Snow in its natural ſtate, and ſqueez'd only by its own weight. In the mean while, when the Snow falls in great flakes, as it is cloſer thruſted together, ſo it makes up more Water than when the flakes are thinner.

6. If the Snow lye long upon the ground, during a great froſt, and ſerene piercing weather, it diminiſhes ſometimes a line and a half in height within 24 hours, both becauſe it ſinks down by its own weight, as that ſome parts of it evaporate, and that the heat of the ground melts it from beneath; ſo that the maſs of the Snow comes at laſt to nothing, if the froſt continue long.

7. The very Ice, how hard ſoever it be, ſteems out and diminiſhes during a froſt, tho ſo inſenſibly, that its decreaſe cannot be perceiv'd but within the ſpace of ſome days.

Out of theſe Experiments and Obſervations, you may infer, that the *Medium* of the quantity of the Rain, that falls at *Paris* within a year, is 19 or 20 inches, and that of the Evaporation is 30 or 31 inches. It were to be wiſhed that ſome of our *Virtuoſo's* would communicate us the Experiments they have made relating to this purpoſe, that we might compare both Climates, and know which of them is wetter or dryer, colder or hotter. This might likewiſe be extreamly ſerviceable to decide the grand Queſtion of the Original of Fountains; for though it ſeems at firſt improbable, that the degrees of Evaporation ſurpaſſing thoſe of Rain by a third, the laſt ſhould be ſufficient to form and keep up Fountains; however the Gentlemen, who maintain that Opinion, know ſo well how to extricate themſelves of this difficulty, as to retort it againſt their Adverſaries; ſo that it will be fit that we ſuſpend our Judgment, till we have heard the Reaſons of both Parties, which I ſhall impartially relate in another Letter and another Month, having been long enough in this, upon this matter.

Jan. 5. LETTER

LETTER II.

To the Honorable Sir *R. S.* P. of the R.S.

ARGUMENT.

Occaſion and Method of this Letter. That the Terreſtrial Globe is not perfectly round, but ſomewhat oval. What the Chaos was, and how it came to be formed into this Earth? That there were Mountains, Rivers, and open Seas before the Flood, and how they aroſe? How the Sea may have overflown the Earth? How the Fountains of the Abyſs were broken up, and furniſhed a ſufficient ſtore of Vapors to a 40 *Days-rain? Conſiderations on the Effects of the Deluge, eſpecially the ſhortning of Mens Lives.*

Honorable Sir,

IT was too raſh an expreſſion to ſay that I might find out half a dozen Romances almoſt as ingenious as that of Doctor *Burnet*, concerning the Formation and Drowning of the Earth: however ſince your Honour has been pleaſed to take me at my word, and to command me to do it, I ſhall make bold to obey your Orders, and uſe my utmoſt endeavours to give you ſome ſatisfaction. Not that I believe I may be able to diſcover the Truth in a matter that can but be known *à Poſteriori*, or by the reflexions we make upon the preſent ſtate of things, which muſt be extreamly altered by the frequent Devaſtations, Inundations, and Earthquakes; without reckoning the inſenſible changes, which the Terreſtrial Globe muſt have undergone, during near ſix thouſand years, or perhaps more: Nevertheleſs, to hit as near the truth as poſſibly I can, I ſhall ſuppoſe nothing contrary to Reaſon and Experience, and much leſs to the Holy Writ.

The late Obſervations of the Pendules ſhortning or lengthning their Vibrations, as they are brought nearer to, or removed farther

off

off from the Equator, aſſure us that the Terreſtrial Globe is not perfectly round, but more extended in length Eaſt and VVeſtwards, than towards the Poles; ſo that the Equinoxial is the longeſt circular line of this Globe, and the polar Axis its ſhorteſt Diameter.

Mr. *Hugens* in his book of the *Gravity*, calculates very exactly this difference, which may amount if I remember well to 16 or 17 miles on each ſide, ſo that I may reaſonably ſuppoſe, that this our Globe is a kind of an Oval and not a perfect Circle: eſpecially ſeeing that moſt of the new Philoſophers agree that the Planets, amongſt which they are pleaſed to rank the Earth, deſcribe anEclipſis about the Sun.

I ſuppoſe in the ſecond place, that the Chaos was a confuſed mixture of Water and Earth, or to ſpeak the Language of the modern Philoſophers, a Compound of material Particles of different Figures, amongſt which thoſe that were round or oblong, tranſparent, ſlippery, ſmall, and moſt proper for motion, may be comprized under the general name of *Water*, as thoſe that were groſſer, and of a more perplexed configuration under that of Earth.

When God had reſolved to diſpoſe this inordinate Maſs into a regular World,the firſt thing he ſeems to have done, is to put it in motion, and at the ſame time inſtituting the Law of Gravity, the Particles of a more perplexed figure ſubſided towards the Center of the Globe,whilſt the more moveable ſwam above the reſt,or crept among the Cavities, which the corners of the groſſer, and their irregular diſpoſitions left betwixt them.

When the firſt commotion was ſomewhat abated: as the Particles of water are ponderous and ſliding, and that they could not make their way towards the Center, being hindered by the ſolidity of the Earthly Maſs, they ran towards the ſides of the Globe; and as they approached the Center as near as they could, they expelled or carried before them ſuch Particles of Earth, as were leaſt able to oppoſe their motion. Thus the Ground came to be diſcovered, and Rivers to form their Beds, which they digged and enlarged more and more, as they went farther off from the tops of the Globe towards the ſides of it, eſpecially when many of them united their force by meeting together.

It follows from this Hypotheſis, that there was no Mediterranean Sea, nor great wide Lakes, as the *Baltick* and *Caſpian* Seas are thought to be; and that the Earth was encompaſſed with the Ocean. But as it appears by the Navigations that have been made round about the Earth, that it is ſtill environed by the Sea: So I hope to make it ſufficiently plain, that thoſe great forementioned Lakes are an effect of the Deluge. I confeſs likewiſe that it does not follow from

my Hypotheſis, that the Primitive Earth, had ſo many, and ſo high Mountains, as our Earth hath at this time; but I do not totally exclude them: Firſt, becauſe I ſuppoſe, that the groſs particles of matter ſubſided unevenly; and left a great many Hills between them: Secondly, becauſe thoſe Hills, which at firſt facilitated the courſe of Rivers, were afterwards increaſed by their running thro them; which could not but dive the ground, level ſeveral inequalities, and enlarge the depth of Vallies. And 'tis eaſy to conceive, that the great changes made by *Noah*'s Flood, and the following Inundations and Earthquakes, in the inward conſtitution and outward face of the Earth, may have produced divers new Mountains, or augmented the bulk of the old ones.

I ſhall not purſue to explain the myſteries of the creation, ſince its other works have no neceſſary connexion with the matter in hand, and therefore I ſhall immediately go over to the Explication of the Deluge.

The account *Moſes* gives of the univerſal Flood, is more circumſtantiated than any other remains of ancient Hiſtory. However, as God deſigned this Revelation for the uſe of vulgar capacities; the ſacred Author has only ſet down ſuch matters of fact, as were neceſſary to underſtand the extent and moral cauſes of this Phænomenon, but has made no Philoſophical Remarks upon them. It ſufficiently appears, that the Divine Juſtice had decreed to exterminate Mankind, and to ſave only the juſt *Noah*, and his Family for his ſake; that as he had reſolved the Earth ſhould be inhabited again, he made choice of the Water, as of a general inſtrument to deſtroy men, without utterly defacing their dwelling place.

The Holy Writ remembers two ways by which God effected this, *viz.* A Rain of 40 days and 40 nights continuance, or the *opening of the Windows of Heaven*, and 2^dly, *the breaking up of the Fountains of the great deep.* By this means the ſurface of the Earth, without excepting the higheſt Hills that then were, was covered 15 Cubits upwards, and the Waters prevailed upon the Earth during 150 days, after which they began to abate. But tho God had raiſed a great Wind to help the Waters to run down, towards their former place, yet it was but on the firſt day of the 10^th month, that the tops of the Mountains began to be ſeen.

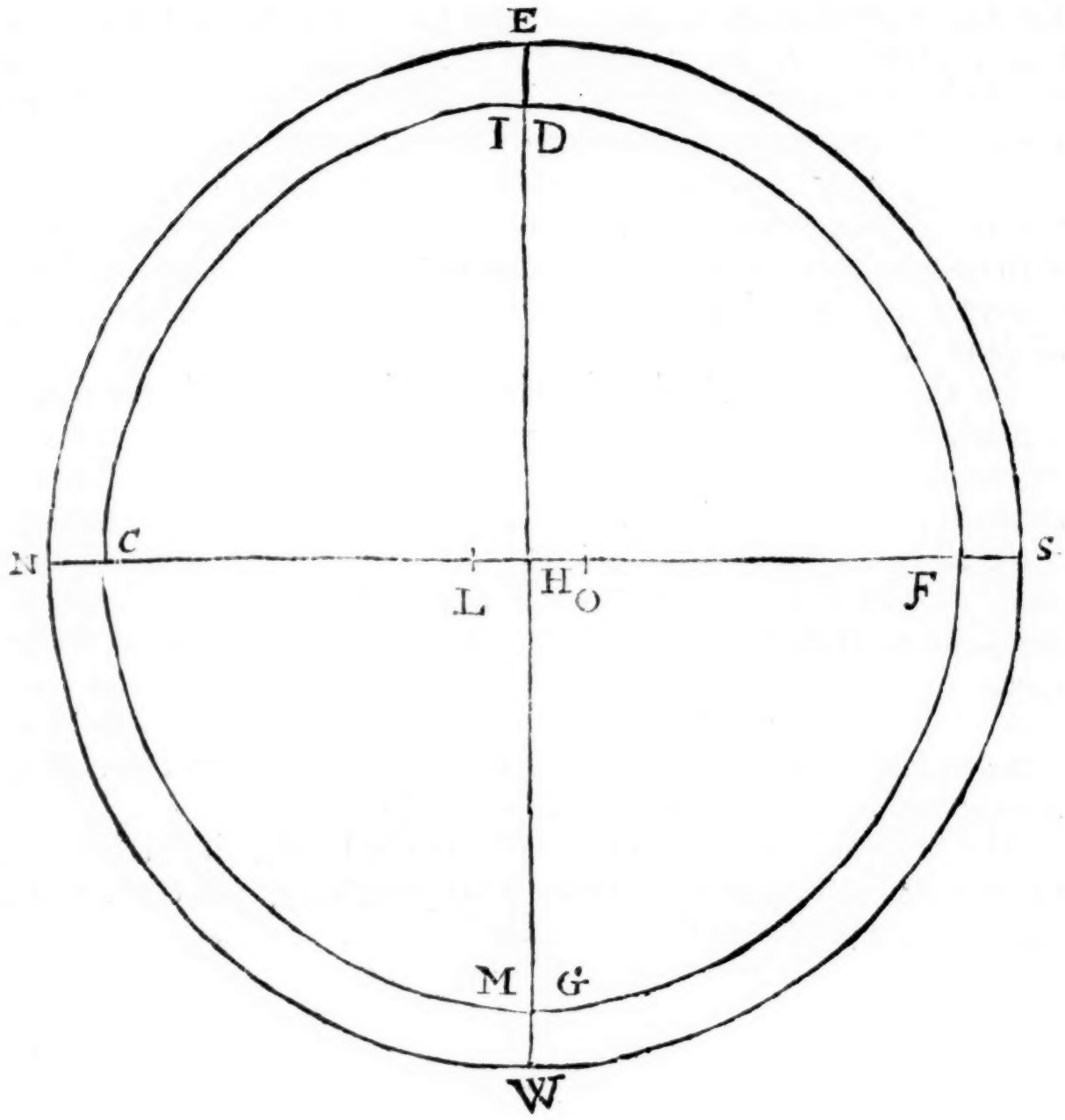
'Tis not eaſy to aſſign the natural cauſes of that great ſtore of Vapors that produced a Rain of ſo long a continuance, for to ſuppoſe that it was preceeded by a proportionable heat and drought, is not agreeable to the Teſtimony of our Savior, *That men were at that time eating and drinking, marrying and giving their Daughters in Marriage*, and

that

that they *were not ſenſible of the Flood, till it came and took them all away.* For ſuch a prodigious drineſs, would have cauſed a Famine, and this a Peſtilence, by which the greateſt part of men and beaſts ſhould have come to their end. The burning Comets of Mr. *Newton*, which reſolve themſelves into Vapors, and ſerve for a ſtore of future Rain, would come nearer to the purpoſe; but this Hypotheſis is not yet ſo firmly eſtabliſhed, as to lay any great ſtreſs upon it: I ſhall only obſerve, that the many Inundations mentioned in Hiſtory convince us, that a Rain continued for many days has nothing incredible in it.

But the great difficulty lyes herein, that it has been plainly demonſtrated, that a Rain of 40 days, how thick and prodigious ſoever it were conceived, could not cover the whole ſurface of the Earth to the height of 15 Cubits, becauſe there are many Mountains that reach above two Miles in the Air. To ſolve this, we need only ſuppoſe, that the Rain fell heavier and thicker upon one of the ſides of the Globe, than upon the other; ſo that the ſurcharged Hemiſphere overweighing the other, the Sea that was then ſpread round about the ſides of the Earth, ran over and drown'd its whole ſurface; which ſeems to be the reaſon that the Southern Hemiſphere is yet more covered with water than the Northern.

The neceſſity of the Sea overflowing the Earth, if this laſt came to loſe its Equilibrium by ſome great weight apply'd to one of its ſides, appears plainly in the following Scheme.



Wherein the Point H repreſents the Center, the Line N S repreſents the Polar Axis or ſhorteſt Diameter of the Terraqueous Globe, N the North, and S the South Pole. E W the longeſt Diameter, E the Eaſt and W the Weſt Points of the Oval N E S W, that ſtands for the Sea or Watery maſs, ſpread round about the ſides of the Terreſtrial Oblong Globe C D F G. Now it is plain, that if a great commotion, as an Earthquake, happens towards the Point W, and withal a conſiderable weight, as a great power of Rain, be added to that ſide, it will overballance the ſide E, and then the Water about W, not being able to be contained between W S N, muſt needs overflow towards I C L and M L C; and likewiſe the Water about E run over towards D O F and G O F, and thus drown the whole face of the Earth.

For

For be pleaſed to obſerve that I do not ſuppoſe that the Waters ran to the ſides of the Earth, becauſe there was a large Cavity prepared for them, but only becauſe the ſides were broader as they are in all Oblong Solides; and that the waters as a ponderous body tending towards the Center, and being hindered to penetrate into it in a direct line by the ſolidity of the Earthly Maſs, they were forced to deſcribe a parabolical one, in running towards the ſides of the Terreſtrial Oval, where they ſtop'd when they could deſcend no lower. It is true that at long run they might ſomewhat have depreſſed theſe ſides, and digged a kind of Cavity: However I ſtill conceive that the waters were higher than the ground about them, ſo that it was not very ſecure to live on the Sea Coaſt at that time, and it was an eaſie matter to drown the Earth again by making it loſe its *Æquilibrium*, and inclining it Eaſt or Weſtwards by a violent commotion, or a conſiderable weight added to one of its Poles. And that this was the conſtitution of the Primitive Earth appears farther by the ſolemn Promiſe God made to Mankind in the Perſon of *Noah*, never more to overflow the Earth, which was very neceſſary, ſuppoſing this facility of drowning it.

The ſuppoſition of the Center of the Earth being removed, does perfectly agree with my Hypotheſis; for if the Center be removed in L, the Hemiſphere I S M L will be greater, and conſequently heavier than the Hemiſphere I N M L: And therefore W will incline towards S, and E towards N, and the waters in W overflow the Earth in M, and the Waters in E the Earth in D. The ſame would happen if the Center were remov'd in O; ſo that the only difference between both Hypotheſis, is that I ſuppoſe neither Miracle, nor any very extraordinary thing.

The overflowing of the Sea would, methinks, ſuffice to raiſe the Waters to the height of 15 Cubits; but that we may have no diſpute concerning the height of the Mountains, I ſhall add another Suppoſition very conformable to *Moſes*'s Account, namely, his mentioning the *breaking up of the Fountains of the great Abyſs*. It is inconteſtable that the Words uſed in the Original תהום רבה ſignify great Hollowneſſes and ſubterraneous Cavities. It is likewiſe undoubted that the Bowels of the Earth are full of Minerals, which being thrown out of their Receptacles by Earthquakes, and mixing with Water and other Liquors hidden in the Earth, cauſe them to ferment and boil: ſo that they, being dilated, and not able to be reſtrained within their former Limits, break open the Ground, and raiſe into Vapors, that are afterwards condenſed into Rain; and as the ſacred Writ joins the *breaking up of the Fountains of the great*

Deep

Deep with the *opening of the Windows of Heaven*; we may reaſonably ſuppoſe that the firſt was the cauſe of the laſt, or the ſource and ſtore of the forty days and forty nights Rain. Thus we need not to have recourſe either to a miraculous Drought, or to the burning Comets.

So much will ſuffice I hope, as to the cauſes and manner of the Flood, I ſhall add but ſome few Periods concerning its effects. Firſt, the Waters, and eſpecially the ſalt Waters of the Sea, having reſted upon the ſurface of the Earth about the ſpace of a year; as they are ſlippery and creeping, and that this power was increaſed by the piercing and corroſive nature of the Salt, they ſtill tending to the Center, as other ponderous things do, muſt needs have made great Holes in the ſurface of the Ground, where ſome part of them ſtill remain'd as in their natural Channels, while the others were driven back to the ſides of the Earth, and our Globe reſtored to its former *Equilibrium*. Thence it comes that it is now cut into ſo many Iſlands, and that there are ſo many Lakes, Streights and Arms of the Sea. 2dly, By the ſame cauſe were brought forth many Hills, or the bulk of the former augmented. 3dly, As to the wild Beaſts that are found in Iſlands, whether to, 'tis not likely that they ſhould have ſwum, or be carried by Men? I anſwer, That theſe places are become Iſlands, by other Inundations and Earthquakes, and that there are ſome, where no devouring Animals are to be found, as Doctor *Ray* relates. 4thly, The moſt probable reaſon, to which the longævity of the *Antediluvian* Fathers may be aſcribed, is the goodneſs of their Food; for I conceive that the primigenial Soil was impregnated with many fat and oily Particles, that turning into the juice of Plants and Fruits, made them an excellent and ſubſtantial nouriſhment. Beſides, it may be collected out of theſe expreſſions of *Moſes*, *That God had not cauſed to rain upon the Earth, but that there went up a miſt from the Earth, and watered the whole face of the ground*, Gen. 2. 6. That before the Flood, the Terreſtrial Globe was not ſubject to thoſe many Tempeſts, exceſſes of Wind, Snow, Hail, Rain, and unconſtancy of weather, to which it is now obnoxious. Add to this the long tarrying of the ſalt Water upon the ground, whoſe corroſive quality muſt needs have extremely altered the conſtitution and pores of the exterior Earth, and corrupted the ſeeds of Plants, and therefore God allowed Men after the Deluge, to feed upon the fleſh of Beaſts, as a more nouriſhing aliment than Fruits were at that time. 'Tis for the ſame Reaſon, that we ſee the life of Men ſhortning ſo faſt after the Flood; for *Noah* that had uſed the beſt part of his life the ſubſtantial Food of the original Soil,

lived

lived 950 years, his Sons that were born an hundred years before the Deluge, remained about ſix Ages alive; but then each Generation had his life ſhortned of a whole Century, till at laſt the period of human life was fixed to a four, five, or ſix-ſcore years.

And thus, Honourable Sir, you have my thoughts concerning the formation and drowning of the Earth, which I do not altogether look upon as a Romance, but ſhould be unwilling to raiſe them higher than the probability of a Conjecture, and much leſs forcibly to impoſe them upon other Men, or to compoſe huge Volumes in their defence. Your Honour ſees I have kept my word ſo far, as to ſuppoſe nothing contrary to Reaſon or Revelation, nor likewiſe to Experience as much as this laſt was known to me; beſides my *Hypotheſis* ſuppoſes no unneceſſary Miracles, to form Rivers, or to raiſe up Hills; no miraculous Providence to lengthen the days of the Creation, or to haſten the effects of natural Agents; no Angel to keep up the Ark, during the terrible Fall of the Ground into the Abyſs, or to ſteer that Veſſel amongſt the ruines of the burſting and cracking Earth.

In a word, this *Hypotheſis* does every way agree with the account of the Holy Writ, the only true Guide we have in this matter. For inſtance as to the going off of the Waters from the ſurface of the Earth, *Moſes* aſſures us, that at the end of 150 days, *God made a wind to paſs over the Earth, and the Waters were aſſuaged.* Suppoſing it to have been an Eaſt-wind, which God made uſe of to drain the Red Sea, and is alſo the moſt draining in this our Country; (any other may do as well) this wind driving the waters to the Weſt, as it diſcharged the Eaſt-ſide, ſo it made the Weſt more ponderous: ſo that the Weſt-ſide by degrees overbalancing the Eaſt, the Terreſtrial Globe returned inſenſibly to its former *Equilibrium* and Figure.

January 12.

LETTER

LETTER III.

To the Reverend Mr. *M. A. D. B.*

ARGUMENT.

The Inconveniences that ariſe from confounding the Idea *of Extenſion or Space with that of Matter; that Matter ſhould then be independant, eternal and infinite, that Spirits and even God ſhould be no-where. Motion demonſtrated impoſſible in this* Hypotheſis. *Reaſons of the* Carteſians *examined. How Extenſion may be call'd the Eſſence of Matter, that Extenſion or Space is penetrable and indiviſible? Whether Spirits are figured? Whether Subſtances penetrate one another? Of the poſſibility of Motion, the World being ſuppoſed full, but not infinite.*

SIR,

(a) Works of the Learned. *Art.* v. (b) Ibid. *Art.* xxxvii.

YOU have too often told me, It was pity that my (*a*) *Demonſtration of the Exiſtence of God*, and my (*b*) *Explication of the Myſtery of the Holy Trinity*, were grounded upon ſuch a weak foundation as the diſtinction between Space or Extenſion and Matter. You have provok'd me to ſet down in writing what Reaſons I could gather for my *Hypotheſis*, being confident that you ſhall ſolidly confute 'em, and make the *Carteſian* Syſtem triumph over the *Epicurean*, as you call it. Sir, ſince my preſent occaſions engage me to the compoſing of theſe *Memoirs*, and that I have not as yet any thing wherewith to fill them, but what is my own or Tranſlations, I am reſolv'd to comply with you, hoping that it will ſucceed better than verbal Diſputes, which would only tend to the diminution of that ſincere friendſhip that has been hitherto between us.

It would not become us to accuſe one another of Prejudice. I confeſs I have reaſon to be in love with an *Hypotheſis*, which has helped me to the diſcovery of two ſuch important Truths, as that the *Idea of God is eſſential to, or innate in thinking Beings*, and that the Myſtery

Myſtery of the Holy Trinity is not altogether incomprehenſible, but that we may, after the revelation of the Goſpel, have as compleat an *Idea* of it, as of any other of ſuch divine Attributes, as immediately depend upon Infinity. You eaſily conceive of what uſefulneſs this would be againſt the *Atheiſts* and *Socinians*, ſo that were it only for this reaſon, every good Chriſtian ought to wiſh the Suppoſition were true.

I. The *Carteſians*, tho' never ſo ingenious, have not yet drawn ſuch weighty Conſequences from a Principle they have ſo long and ſo curiouſly wrought upon; but their Adverſaries (*c*) are more ſucceſsful; for they ſhew that all the Arguments *Des Cartes* or his Diſciples have brought forth for the Exiſtence of God, or the Immortality of the Soul, are either falſe, or grounded upon thoſe Notions which they ſtill hold in common with other Philoſophers. Nay, it may be proved that this confuſion of the *Idea's* of Space and Matter, directly leads to the groſſeſt Atheiſm that can be imagin'd, in aſcribing to dull Matter the moſt incommunicable Attributes of the Supreme Being, *viz. Eternity, Infinity* and *Independance*. This Proof runs thus: Objects or things are ſuch as they are repreſented by their *Idea's*; for if Objects were not wholly like to their *Idea's*, we had no ſtanding Rule to judge of 'em, and conſequently we could know nothing certainly. But we have an *Idea* that cannot be annihilated, nor even ſuppoſed to be ſo, *viz.* that of Extenſion or Space, which is the ſame as Matter, according to you; for ſuppoſing all *Idea's* and Objects whatſoever, to be annihilated, beſides me thinking, who could not otherwiſe make this Suppoſition; there remains ſtill the *Idea* of Space inſeparable from my thought; for then I ſhall think only upon an unlimited Extenſion. An Argument that has ſo puzled one of the moſt skilful (*d*) Champions *Carteſianiſm* ever had, that he is forced to aſſert, that the *Idea* of Extenſion is eſſential to the Soul. But who has told him that this *Idea* is not alſo eſſential to Angels? I am ſenſible that it is a pure intellectual *Idea*, not to be annihilated by death; for if it were to be ſo, I do not know what ſhould remain of me.

(*c*) *Dr.* More's *Enchirid on Metaphycum and Divine Dialogues. F. Daniel's Voyage into the world of Deſcartes.*

(*d*) *Regis*

But to return to my Argument: That which cannot be annihilated, nor even ſuppoſed to be ſo, is independant; but the *Idea* of Extenſion, or Matter, according to you, cannot be annihilated, nor conſequently Matter it ſelf; for Objects are wholly like to their *Idea's*, and therefore Matter is independant. Moreover, that which is independant, is eternal; for if it had a Beginning, it ſhould depend upon the firſt Author of its Being, and ſo could not be alto-

gether independant; neither can we conceive that any thing that was not could bring it ſelf into Being.

As to the intended infinity of Matter, it is not neceſſary to be proved; for infinity is really included in the *Idea* of Extenſion, wherewith they confound Matter, and the *Carteſians* have drawn themſelves this Conſequence from their Principle. At firſt their Maſter was aſham'd to own it, and would only uſe the word *Indefinite*. But the moſt learned and ſincere of his Diſciples, as *Malebranche* and ſome Gentlemen of *Port-Royal* have ventur'd farther, and will plainly tell you, that the World is infinite, that Matter is infinitely diviſible, that the ſmalleſt portion of Matter contains infinite Particles, *&c.* Theſe Philoſophers make nothing of infinite; for they are as laviſh of them as a Poet, who is infinitely in love, adores an object infinitely charming, *&c.*

II. Indeed, Sir, you have there a fine Syſtem, and worthy that a Reverend Divine ſhould ſtand for it, *tanquam pro aris & focis*, with as much Zeal as a true *Engliſhman* for the Proteſtant Religion, and the Liberties of his Country. I ſincerely proteſt that were mine liable to one half of theſe inconveniencies, I would rather forſake all metaphyſical ſpeculations, than philoſophize at ſuch a dangerous rate. But what will you ſay to that other conſequence, likewiſe confeſt by ſome of your Tribe, that Spirits, and even God himſelf, are no-where. One that ſhould not be us'd to your Language would be apt to believe that you deny their Exiſtence, for all mankind hitherto has look'd upon *not to be*, and *to be no-where*, as ſynonimous Phraſes, and *Carteſianiſm* may well be of a Thouſand years ſtanding, and make far greater progreſſes than the *Peripatetick* Philoſophy ever did, before it can root this notion out of the hearts of men. It's the common opinion, and the neareſt, methinks, to the Truth, that ſpiritual Agents are not circumſcribed in a certain place, for they have not, for ought we know, any determinate figure, and as they are penetrable, ſo they do not fill up a certain ſpace, as do the ſolid particles of bodies. But your Gentlemen go farther, and as they are ſenſible, that if they grant that a Spirit is here or there, they muſt allow withal that it is extended ſome way or other, and thus bid the laſt welfare to their beloved notion of the idenity of extenſion and matter, they rather chuſe to ſay that it is no-where, not even in the center of its operation. But will one ſay, then it is not at all, no, anſwer they, it is, but it is in no place; for, add they, *place*, *ſpace*, *body*, *extenſion* and *matter*, are all ſynonimous words. If

Peri-

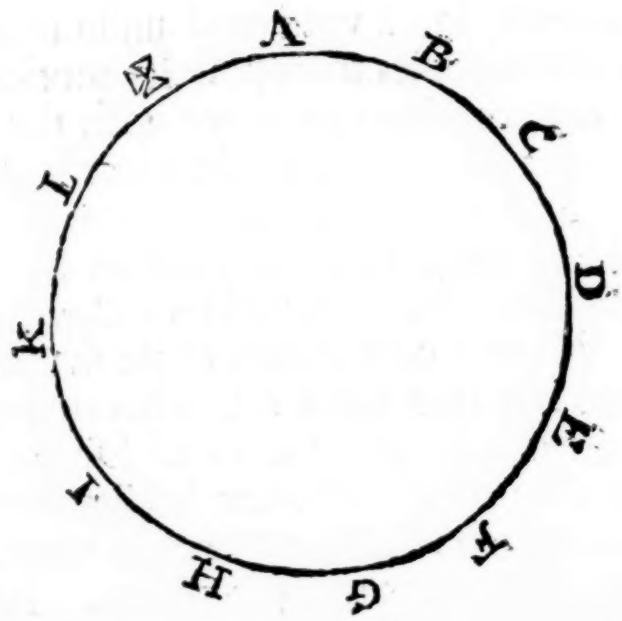
Peripateticiſm, ſo much laugh'd out of the doors, did ever aſſert a greater abſurdity, I am content to turn a *Carteſian* my ſelf.

III. You remember the pleaſant device of that ancient Philoſopher, who to elude the objection drawn from the impoſſibility of motion, if all be ſuppoſed full, began to walk into his School-hall: but the good man cut the Knot, which he could not unty. I do not know whether he held the world infinite; if not, he might have anſwer'd more rationally, as I ſhall do anon; but I defie any *Carteſian*, or whoſoever maintains matter to be infinite, and to have been thus infinitely extended without any interſtices from the beginning, fully to anſwer the following Argument. Matter is not only incapable of motion, as is confeſſed on both ſides, but I obſerve farther that it actually reſiſts motion. For let's ſuppoſe a ſmall poliſh'd Globe moving in a void and unlimited ſpace, where it ſhould meet no other bodies to oppoſe its motion; we conceive that it would for ever continue to move with the ſame degree of motion, and in a right line, towards the place it had been at firſt directed; becauſe bodies have a tendency to remain in the ſtate they are in. It would be a begging of the queſtion to alledge, that the ſuppoſition is impoſſible; for none beſides a *Carteſian*, ſees any impoſſibility in it. Whence does it then come that the moving force of terreſtrial bodies is ſo ſoon ſpent? It is becauſe motion is the beginning, and the moving force the cauſe of Diviſion; and that this World is full, or almoſt full, of other bodies, compounded of divers ſolid particles, which tending to remain thus united, reſiſt the moving body that endeavours to ſeparate 'em. No wonder therefore, if Guns, the ſtrongeſt Engine that men could invent, cannot carry a Bullet, the moſt proper body, to make its way through the reſiſting air, farther than a mile or two, ſince in that ſhort ſpace it meets with many millions of corpuſcles, which oppoſe and deaden its motion.

If the Air, which we are apt to believe incapable of reſiſtance, damps the moving force ſo quickly, what will Marble, and the leaſt porous bodies do? for every one knows that the reſiſtance to motion and diviſion is proportionable to the various quantity of pores; ſo dry Wood is lighter and burns eaſier than green, Diamonds and Gold are harder and heavier than other Stones and Metals. This being ſuppoſed, if God created an infinite maſs of Matter, he imprinted Motion to its parts, either at the very moment of its Creation, or afterwards. But that he did not imprint it at that very moment is plain, becauſe then motion would be natural to matter, as it

is natural to men to think, to live, to grow and to dye; whereas motion is ſo far from being natural to matter, that it has a repugnancy to it, as has juſt now been obſerv'd.

Now I am to prove that matter being created infinite, God Almighty himſelf could not give it a motion. A very hard task, I confeſs, not ſo much in it ſelf, as for the ſake of ſome ſcrupulous people, who imagine that it is a detracting from the power of God to aſſert that he cannot do contradictory things, without conſidering that they are no things at all. For my part, I am perſwaded that God can do whatſoever is conſiſtent with his wiſdom, holineſs and other perfections; but a contradiction is a meer nothingneſs, becauſe it affirms and denies the very ſame thing, at the ſame time and in the ſame reſpect, as I hope to make it out of the motion of an infinite matter.



Suppoſe ABCDEFGHIKL to be a Sphere infinitely extended every way; and an infinite power applying itſelf to A, or any other imaginable point of the unlimited circumference, if there may be ſuch a thing in an infinite maſs, in order to move A towards B, and ſo to divide the whole, I ſay it ſhall not compaſs its end, for while A moves with an infinite force towards B, B is repulſed with an equal infinite force by C, C by D, D by E, E by F, F by G, and ſo *in infinitum:* and therefore they muſt continue in the ſame State. As to moving the whole body of matter, beſides the unprofitableneſs of that ſuppoſition, in order to the formation of the World, it is as impoſſible as the former; for as long as you ſuppoſe matter infinite, there is no room for it to move in.

By the Laws of diſputation none is oblig'd to prove a negative; ſo that I have done more than you could reaſonably expect, in raiſing

ſuch

ſuch objections againſt your confounding the Idea's of extenſion and matter, that the laſt of 'em ſeems to me a demonſtration I do not know how you can rid your ſelf of theſe difficulties. However I am willing to examine what I have heard or read that is moſt probable for the aſſertion of your *Hypotheſis*.

1. The Eſſence of things is taken to conſiſt in the firſt general property that we conceive in them, but extenſion is the firſt general property that we conceive in bodies, and therefore extenſion is the eſſence of bodies. I anſwer, that extenſion or ſpace abſolutely taken, and in its moſt abſtract and univerſal notion, is not the firſt general property of bodies; but that it is extenſion modified, extenſion limited and inſeparably joyned with impenetrability and diviſibility. So thinking may be called the eſſence of Spirits; however thinking in general is not the eſſence of men, but thinking modified a certain way, thinking by Idea's, form'd or excited by the ſenſes and our Reflexions thereupon.

2. The Idea of extenſion includes impenetrability and diviſibility, but theſe two laſt properties are the diſtinguiſhing characters of matter or bodies, whence it follows that all extenſion is impenetrable and diviſible, and by conſequence that extenſion and matter are one and the ſame. The firſt propoſition is again equivocal: for abſolute extenſion or ſpace is penetrable and indiviſible, and 'tis only extenſion modified, joyned and mixed with matter that is impenetrable and diviſible. That extenſion in itſelf is penetrable, appears by that our Ideas repreſent infinite extenſion to us as incapable of being annihilated, independent and eternal, whereas we plainly ſee that each part of matter, and conſequently the whole can be annihilated by an almighty power: for we eaſily conceive that God can annihilate all the bodies that fill up a certain ſpace, as this Chamber; and to alledge that there ſhould then remain no extenſion, and that the Walls ſhould immediately touch one another, is a ſhameful begging of the queſtion. We may imagin that ſome of the ambient corpuſcles would penetrate through the pores of the Walls, as it happens in the Air-pump, or that finding no reſiſtance from within they ſhould break down the Walls, and dilate themſelves in the void ſpace; but if the Walls were ſuppos'd unmoveable, or ſo ſtrong as to withſtand the action of thoſe impreſſing bodies, then the ſpace ſhould remain void of ſolid matter, and only be filled with a penetrable extenſion. It's known how much this Argument has puzzled the *Carteſians*, who have no other way to ſolve this difficulty, but by ſaying that their Adverſaries argue from impoſſible ſuppoſitions. But let this ſuppoſition be what it will, my objection remains in its whole force,

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ſince infinite ſpace having been prov'd independent and eternal, and matter annihilable and created, it plainly follows that the laſt was created within the ſpace, or part of the ſpace that was taken up by that infinite extenſion, and conſequently that infinite extenſion is penetrable.

As to the indiviſibility of the infinite ſpace, it may be thus demonſtrated. The moving force is the cauſe of diviſion, and motion its beginning; but by the inſtance of a ſphere infinitely extended in all its dimenſions it appears, that an infinite extenſion is unmoveable, and by conſequence indiviſible. And leſt you ſhould object that I only argue *ad hominem*, or commit the ſame fault that I charge you with in confounding the notions of extenſion and matter; I pray you to obſerve, that I can alſo prove this indiviſibility from the independency and eternity of infinite extenſion, and likewiſe from its ſimplicity; for we do not ſee why a moſt ſimple being, free from any heterogeneous bodies, from any mixture or compoſition whatſoever, ſhould be diviſible.

Notwithſtanding you will urge that this is a meer Sophiſm, becauſe we meaſure and really know the diſtance from one place to another, without taking notice of the interjacent bodies; and whether the interval is fill'd up with matter or not: that this is the ground-work of all the Mathematicks, of the moſt part of other Arts and Sciences, and even of common Converſation.

But, Sir, for all that, you have not gain'd the point: for 'tis compounded Matter, and not ſimple Extenſion, that we divide or meaſure. When we ſay, for inſtance, that *Rouen* lies 69 miles North-Weſt of *Paris*, that is but a ſhort way of ſpeaking that ſerves our purpoſes as well, as if we had ſumm'd up all the moſt minute Corpuſcles that are betwixt both Cities. And if you think well on't, you will quickly perceive, that were all theſe Corpuſcles annihilated, you would come but very hard to the diſtant knowledge of that diſtance, for then you would be forc'd to fetch it from more remote bodies; and ſo bodies are ſtill the meaſure of other bodies, and not extenſion of bodies or matter. I will not overthrow common language, but will not be ſeduced by it. It is neceſſary that we ſhould make an imaginary diviſion of the ſpace or infinite extenſion, becauſe we cannot comprehend infinity, nor exactly ſumm up all the ſmall bodies that lye between two others. As in Geography to know the Longitude and Latitude, of the Climates and Seaſons, of the Air and Soil of different places, we ſuppoſe ſeveral Circles in the Heavens, an Equator, a Zodiack, divers Meridians, five Zones, two Tropicks, two Polar Circles, *&c.* But was ever any Geographer ſo mad as to imagine that there

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are ſuch Circles really in nature? And how can Philoſophers conclude that extenſion is diviſible, tho it be demonſtrated to be moſt ſimple, only becauſe the bodies contained in it are meaſurable one by another.

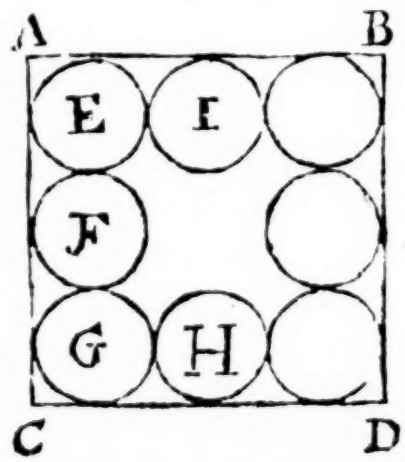
3. Now I come to the main pillar of your Hypotheſis. Whatever is extended is figur'd, for it is terminated ſomewhere; but whatſoever is figured is material, then whatſoever is extended is material. The firſt propoſition is utterly falſe, ſince infinite extenſion has no figure, being terminated no-where; neither do the imaginary diviſions of the ſpace give it any proper and real bounds, terms or figures, it being in it ſelf indiviſible, as it has been demonſtrated. Thus falls by courſe your grand objection againſt the immateriality of Spirits, in our Syſtem. All that is ſomewhere, and may be ſaid to be here and not there, is figured, for it's terminated; but according to us, Spirits are ſomewhere, for otherwiſe they would not be at all; then Spirits are figur'd, and conſequently material. Firſt, your objection does not reach the eſſence of God, which being infinite has neither bound nor end. Secondly, As to finite Spirits, their ſtate is ſo far unknown to us, that we only know that they are thinking beings, that they are contain'd in the immenſity of God, as all other things are; that God grants them ſometimes the power of moving ſome parts of matter, more or leſs, as he thinks fit; but it does not follow that they are eſſentially united to the matter they move, no not our Soul to the Body it actuates; for it has no neceſſary dependance upon, but can ſubſiſt ſeparated from the body. And tho Spirits might be ſaid to be figured in a very improper ſenſe, and in reference only to the matter they operate upon; yet it cannot be infer'd that they are really ſo, becauſe they participate ſo far of the divine nature, as to be penetrable and indiviſible, and cannot have therefore any proper figure. True it is, that upon the account of their limited eſſence we may ſay that they have ſomething analogous to a figure, but what this is, is altogether unknown to us.

4. But you ſtill urge that my Hypotheſis includes the penetration of ſubſtances: Yes by all means, of ſubſtances of a different genus, as Spirits penetrate bodies, and bodies ſpace. But that does not ſignifie that an imaginary part of ſimple place or extenſion penetrates another, for ſimple extenſion is unmoveable and indiviſible; nor that matter penetrates matter.

Laſt of all, you will ſay, that 'tis an eaſie thing to raiſe Objections againſt any hypotheſis, but very difficult to propoſe one that ſhall be free from any great inconveniences. However I hope to do it; but ſuch a performance requires a Letter longer than this. For a concluſion, I will ſhew you, as I promiſed, that the motion of

of the World may be explain'd, tho it be ſuppoſed full, provided it be not conceiv'd infinite : For if the Sphere A H D E be imagin'd finite, tho the whole maſs be never ſo great; notwithſtanding, as there is no proportion betwixt finite and infinite, A moving with an infinite force towards B, and B reſiſting but with a finite force, muſt immediately puſh forth C, and C, D, and thus the whole maſs be divided in a moment. The diviſion being made, and the whole maſs being ſeparated into ſeveral particles, whereof ſome are extreamly thin, round, ſlippery and proper for motion, any part of the great maſs may be mov'd, tho there be no void ſpace left, provided a ſufficient quantity of theſe particles continue in agitation.

See the fig. of p. 5.



For let the Square A B C D be the Lid of a Box, E F G H I a circle of round Musket-balls, the void ſpace of the Lid and the interſtices of the Balls be fill'd up with liquid and agitated matter, as are the corpuſcles of the Air. As ſoon as you move E, it will communicate its motion to F, F to G, G to H, and ſo ſucceſſively till it comes to I, which takes the place of E at the very inſtant that E moves from it. And thus you ſee the reaſon why I ſaid in my demonſtration of the Exiſtence of God, that my hypotheſis did not ſuppoſe the little void ſpaces of *Epicure* or *Gaſſendi*.

January 21.

LETTER

LETTER IV.

ARGUMENT.

New Experiments on the Loadſtone; of a Needle touch'd with it, and plac'd directly over the Needle of a Compaſs; of two Mariners Needles hang'd freely one over another, at ſeveral diſtances; of a touch'd Steel-Ring. Reaſons of theſe Experiments. The Earth Magnetical.

SIR,

I Thought to have ſent you this time ſome excellent Obſervations concerning a prodigious Muſhroom, out of the *Phyſical and Mathematical Memoirs*, together with an occaſional Diſcourſe of Mr. *Tournefort*, a Member of the *Royal Academy of Sciences*, about the generation of Plants, and their inſenſible Seeds; but the Cuts, on which theſe Obſervations depend, not being ready, I was forc'd to wave it till another Month, and put in the place ſome new Experiments of Mr. *De la Hire* on the Loadſtone *. * *Aug.* 31. 1692.

Having divided the braſs Circle of a Compaſs into 360 degrees, he put in a Mariner's Needle of 3 Inches and an half, which freely turn'd upon the Pin; and he mov'd the Box, till the Needle ſtopp'd upon 360 degrees. Then having cover'd the Box with a Glaſs, he plac'd another Needle of the ſame length, and likewiſe touch'd with the Loadſtone, upon the Glaſs, without any Pin; ſo that the North Point of this Needle anſwer'd directly the North Point of the former, which playing freely in the Box, turn'd preſently to the Weſt, and after ſeveral Vibrations its North Point ſtopp'd 42 degrees Weſt of the North Point of the uppermoſt Needle that was unhang'd.

Mr. *De la Hire* took notice that the declination of the hang'd Needle, rather to the Weſt than to the Eaſt, proceeded from a particular cauſe, *viz.* that he had caſually plac'd the North Point of the uppermoſt Needle about a degree more to the Eaſt than to the Weſt

of the Under-Needle. And therefore having taken off the uppermoſt Needle, and the other turning preſently Eaſtwards, he put the ſecond Needle upon the Glaſs again, and obſerv'd that the North Point of the Under Needle after ſeveral Vibrations, none of which however reach'd ſo far as the North Point of the uppermoſt Needle, ſtop'd at laſt 41 degrees Eaſt of that Point, that is about the ſame diſtance as in the former Experiment.

Then removing the uppermoſt Needle again, and giving time to the other, to return as it did to 360 degrees, he put the ſecond Needle upon the Glaſs, ſo that its North Point inclin'd to the Weſt, and made a right Angle with the under Needle, whoſe North Point turn'd immediately toward the Eaſt and the South Point of the uppermoſt, ſo that when it reſted, it was at 13 degrees from the 360, its natural place. In vain he labour'd to make the North Point of the under Needle paſs to the Weſt, for after many Vibrations, it ſtill declin'd toward the Eaſt and the South Point of the uppermoſt Needle, keeping at the ſaid diſtance of 13 degrees from its natural Poſition.

He therefore tranſpos'd the Points of the uppermoſt Needle, turning the North Eaſtwards, then the North Point of the under Needle declin'd towards the Weſt and the South Point of the other, keeping ſtill at 13 degrees from its natural Poſition, or 77 degrees from the South Point of the uppermoſt Needle: but when he brought this Point ten degrees nearer to the North Point of the under Needle, this North Point declin'd but five degrees nearer to the South Point of the other, ſo that both Points remain'd ſtill 62 degrees diſtant one from another. But advancing the South Point of the uppermoſt Needle yet five degrees nearer, the North Point of the under Needle came quickly to join the South of the uppermoſt; ſo that the Points of different name lay directly one over another. And now the North, then the South Point of the under Needle beat againſt the Glaſs, as tho' it ſought to unite it ſelf with the oppoſite Point.

After theſe Experiments, Mr. *De la Hire* had a mind to try what effect theſe two Needles would have upon one another, if they were both free; in order to which, he put the uppermoſt Needle upon a Pin directly over that of the Needle included in the Compaſs, and at ten lines diſtance one from another: But what motion ſoever he could give to theſe Needles, their North Points turn'd ſtill to the North; however ſo, that they remov'd 46 degrees one from another, one Eaſtwards, and the other Weſtwards, according as they were determin'd by the motion he had given them: Each Needle

being

being equally distant from the 36th degree. The same happen'd when he put the uppermost Needle upon a very low Pin, so that it was but at four lines distance from the under Needle, the Glass being between both. Only with this Exception, that when he placed the South Point of the one upon the North Point of the other, after some Vibrations, they remain'd thus united. Whence he draws this vulgar Inference, that the nearer the Needles are, the greater is their working one upon another.

This Author has propos'd some years ago, a new way to make a Mariner's Compass with a Steel Ring touch'd with the Loadstone. This Ring he put upon the higher Pin ten lines above the under Needle, and observ'd that at such a distance this Ring had as much and more power than the uppermost Needle, when he plac'd it but at three or four lines from the under; for being in motion they did not stop, till the Poles of different name in the Ring and the Needle were join'd together, or directly opposite one to another.

These Experiments partly agree with that vulgar and well known Property of the Loadstones, that their Poles of the same name drive away, or remove one from another, as far as they can. Thence it comes, that two Loadstones that are free, or two Mariners Needles that are hanged one over another, move so long till their Poles or Points of different Name, the North and the South, be directly opposite; the Diameter of the Circle they describe in their removing, being the greatest distance they can be at.

This, however, seems to be contradicted by one of the foregoing Experiments, wherein the North Points of two touch'd Needles freely and directly hang'd one over another, did only remove to the distance of 46 degrees, without joining together by their contrary Points. To explain this, Mr. *De la Hire* supposes that the mass of the Earth is a great Loadstone, which directs the Poles of the same name in all the Loadstones and touch'd Needles, towards the same place of the Earth; so that the two hang'd Needles do but remove from this natural Position by the particular force they have of driving away each others Poles of the same name; which force in a certain degree is not sufficient to overcome the power of the great Loadstone of the Earth. But if a foreign force remove these Needles so far, as to make their particular virtue superior to that of the earthly mass, then they will presently unire by their contrary Poles.

You may likewise have observ'd, that in the Experiments where one of the Needles was unhang'd, that which played freely in the Box remov'd but so far as to make with the other an Angle of 41 degrees, or thereabouts; whereas when they were both free, they

made an Angle of 46 degrees. This hapned becauſe the unhang'd needle was turned to the North, whitherto the hang'd needle was alſo directed by the poiver of the earthly Loadſtone, but driven from it by the particular virtue of the unhang'd needle; which however could not have ſo great a force as both needles together, when freely hang'd; for they then acting one againſt another, with an equal force, did more effectually overcome the power of the Load-ſtone of the Earth, and remove themſelves at a greater diſtance.

This Hypotheſis is confirmed by the experiment of the touch'd Steel-ring, which as it has more magnetical virtue in it than a Mariners needle, ſo the Poles of a contrary name, in the Ring and the Needle, did preſently joyn together, that is, the North of the one, with the South of the other, in what ſituation ſoever they were placed.

Mr. *De la Hire* promiſes us ſome new experiments on the Loadſtone with the reaſons of it, which if they come to my hands, I will not fail to ſend you.

January 20.

LETTER V.

ARGUMENT.

Two Opinions about Petrification; that both may have place in different caſes: This evidenc'd in ſeveral inſtances of pretended Petrifications. Of two pieces of the Trunk of a Palm-tree ſuppoſed to be turn'd into Stones: Whether they were really ſo? The cauſes of Petrification by Water.

SIR,

IN your Cabinet of Rarities, you have ſeveral of thoſe curiou Stones, which are ſaid to be petrify'd Wood, but you give little credit to this relation, and rather take it for a *play* of Nature: Who among the various forms it gives to theſe hard ſubſtances, ſeems ſome-

ſometimes to take a pleaſure in framing them in the likeneſs of the trunk or the branches of a Tree.

You are confirm'd in this opinion by the uncertain account Geographers give of ſome Fountains, and other Waters, to which they aſcribe this vertue of petrification. They talk of a Pond near *Armagh* in *Ireland*, where if you ſtick in a Spear, that part which is faſten'd to the Mud ſhall be all Iron, that which is wath'd over with the Water ſhall be chang'd into a Whetſtone, and that which is out of it ſhall remain Wood. In the Northern part of the ſame Province of *Ulſter* is, ſay they, a Fountain, which turns Wood into Stones; but ſeven years are requir'd to finiſh this tranſmutation. At *Loches* in *Touraine* is a Spring that petrifies whatſoever is thrown into it: and at *Sens* in *Champaign* runs a ſource near a Lake, whoſe Waters harden into Stones. But as you doubt of the marvels of thoſe *Iriſh* Waters, ſo I am not certain of the transforming virtue of theſe *French* Fountains, having never read of it in any credible Author beſides *Varenius*, whom I eſteem more for his eaſie method and Geometrical order, than for any matters of fact that he relates.

If we had no other Authors to truſt to in this matter, your doubts would not be ill grounded; but that curious obſerver of Nature, the late Honourable *Robert Boyle*, has given ſo many inſtances of Wood petrify'd by Water, in his *Hiſtory of firmneſs and fluidity*, that the matter of fact can hardly be doubted.

The Ingenious Dr. *Grew*, in his deſcription of the Rarities of *Greſham* Colledge, gives an account of ſeveral petrify'd Plants, and alſo of Stones like to them. For as he writes without prejudice on either ſide, it appears by his diſcourſe that ſome of thoſe Stones that are ſuppos'd to be petrify'd Plants, are Stones originally, in which Nature ſeems, as it were, to imitate the figure of theſe Plants. The ſame Judgment Mr. *Liſter* makes of ſome Stones found in our *Engliſh* Quarries, that are taken for petrify'd Shells, *Phil. Tranſ.* N. 16. *p* 282. You will find in the *Philoſophical Tranſactions* inſtances of Stones form'd in the bodies of Animals, and even of the *Glandula Pinealis* petrify'd in the brain of a man, that liv'd yet ſeveral years after; of Trees petrify'd in a Sandy ground; of Aſhes of dead bodies tranſmutated into Stones in a Sepulchre; and I am credibly informed that near *Bungey* in *Norfolk* there is a Well endow'd with this virtue of petrification; for a Gentleman of our acquaintance ſaw ſome Sticks in it half Wood and half Stone.

* *p. mihi* 270.

But be it how it will, Mr. *de la Hire*, one of the moſt famous of the *French Academy of Sciences*, has thought fit to take the affirmative, or to aſſert the reality of this petrification by the occult qualities of ſome

Phyſ. & Math. Memoirs, July 31, 1692.

ſome Waters. It was on this occaſion: The Abbot of *Louvois* preſented to the *Royal Academy*, two pieces of a Palm-tree turn'd into Stones as he ſuppoſes; and withal two others of a real Palm-tree, very like to theſe Stones; that by comparing them together, it might be diſcover'd whether theſe Stones had formerly been real Wood, whoſe nature had been thus tranſmutated.

He was told that both the Stones and the Wood were brought thither from *Africa*. As to the Stones, none can doubt but that they are real, for they are as hard as Marble; their colour is dark in ſome places and tranſparent in others, their ſound clear and piercing, and their gravity ſurpaſſes ten times that of the two bits of the true Palm-tree. To which he adds, that for the reſt, theſe Flints are ſo very like to thoſe pieces of Wood, that it is altogether improbable that meer chance ſhould have form'd two bodies ſo reſembling one another.

One of theſe Flints, which he takes for part of the trunk of a Palm-tree, whoſe rind had been torn off, has 4 or 5 Inches diameter, and about two foot in length. There this quick-ſighted Gentleman could diſtinctly perceive the fibres of the Wood, $\frac{2}{3}$ of a line thick, and ſome of them forked: all reaching along the trunk, and hollow within as a pipe; which he ſuppoſes to come from that the tender marrow, if I may ſo call it, that joyn'd thoſe fibres together, was chang'd into a kind of very hard glue.

This he confirms by the following obſervation. That when long and ſoft bodies, but ſomewhat heavy, come to dry, the exterior part hardening by little and little, makes a kind of a vault round about them: Whereas the inward part, that is leſſer, draws by degrees from the center to the circumference, and ſticks at laſt to the outſide; ſo that when the whole matter is harden'd, there muſt needs remain an hollowneſs, in and along the dry'd bodies, which have then the form of Pipes. As it is by this mechaniſm that moſt of the marrow-plants, and the biggeſt ſprouts of ſome Trees become concave, ſo the Author conjectures that the fibres of his pretended Palm-tree have been thus excavated.

After all, he confeſſes, that ſince the trunk of a Palm-tree is only made up of direct fibres, it may be doubted, ſays he, tho with little reaſon, whether chance has not framed the firſt Flint, which he has juſt now deſcribed, in the likeneſs of that trunk; but as to the ſecond Flint, repreſenting the bottom of the trunk of a Palm-tree, he thinks it inconceivable, that that ſhould have been thus caſually ſhaped: which he endeavors to prove in the following manner.

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The piece of true wood, repreſented by the ſecond Flint, is not only made up of right fibres as the former, but from its Bark ſprout Roots, thick as the little finger, about 3 inches in length, and covered with a thin skin, that includes a great many ſmall fibres as fine as a hair. In the middle of the little fibres, that make up the body of each root, is a woody ſtring, that may be called its kernel, which is of the thickneſs of a third of the little finger, hollow and full of ſoft marrow.

Now he pretends that all theſe different parts are plainly to be ſeen in the ſecond Flint, that beſides the long and right *fibres* that make up its body, the roots, which for the moſt part appear as ſeparated from one another, may be eaſily diſtinguiſhed; that the ſmall *fibres* of each root have been turn'd into a blackiſh and ſhining Flint, but the kernel into a whitiſh and dark; and that the marrow wherewith it was fill'd before its petrification being dry'd up, this kernel remained empty and hollow as a Pipe in moſt of the roots; which hollowneſs he aſcribes to the ſame cauſe that had excavated the ſuppoſed *fibres* of the former Flint.

This Deſcription ſeems pretty accurate, the reſemblance very great, and the obſervations ingenious, but when all is done, 'tis pity that he who brought both the Stones and the pieces of Palm tree, from *Africa* into *France*, was no Philoſopher, and has given us no account of the place he found them in, whether in a River, or on the dry ground, as alſo of the conſtitution of the Climate and Soil round about it: for till then I do not ſee that we are ſufficiently enabled to decide the grand queſtion, Whether this likeneſs is an imitation or a transformation of Nature?

Our Author however thinks to have found an inconteſtable Proof of his Opinion in a Paſſage that he quotes out of the *Phyſical and Mathematical Obſervations of* F. *du Chatz*, where he ſays, "That the "River that goes through the Town of *Baham*, in the Kingdom of "*Ava*, has in this place the virtue of petrifying Wood during ten "Leagues; that he has ſeen there conſiderable Trees, petrify'd to "the very ſurface of the Water, whereof the reſt was but dry "Wood; and that this petrify'd Wood was as hard as a "Flint.

Both *F. du Chatz*, and Mr. *De la Hire* would have oblig'd us, had they taught us the nature of this River Water, which, if what is related be true, muſt undoubtedly be mineral: for ſo far I conceive this tranſmutation poſſible, *viz.* that Wood being ſoft and porous, and the Corpuſcles of Minerals, as Vitriol, Marcaſſites, and the like, hard and piercing, creep into the Pores and inward part of the Wood,

Wood, expel its ſofter Particles, that become more and more agitated and liquid by the motion of the Water, and ſqueezing the hardeſt and remaining Particles of the Wood, form at laſt together a ſtony ſubſtance. The ſame may be ſaid of ſuch Fountains to which is aſcrib'd the virtue of turning Wood into Iron or Copper. Thence alſo follow, that the more the Water is impregnated with mineral Corpuſcles, the ſooner the Tranſmutation is perform'd.

But the accurate Compariſon Mr. *De la Hire* makes, between his two Stones and the two pieces of the trunk of a Palm-Tree, would rather perſuade me that they are Stones originally, than Wood tranſmutated; for ſuch a Tranſmutation ordinarily hapning by the expulſion or evaporation of the ſofteſt Particles of the Wood, and the acceſſion of harder Corpuſcles, as thoſe of Minerals are; it ſeems that this permutation ſhould make ſo great a change in the conſtitution of the Wood, that it would retain but very little of its former figure.

That this Tranſmutation is made by the Minerals that are mix'd with the petrifying Waters, appears by an Inſtance we have in *Darbyſhire*, where Water falling along the inward ſide of a deep Cavern, petrifies before it be at the bottom. I ſay, that it petrifies, and not that it freezes; for tho' Cold may help to the condenſation of the mineral Particles, yet it cannot turn the Aqueous into Stones.

January 31:

FINIS.